



**VOLUME I OF II  
RFI PHASE II REPORT  
DELAWARE VALLEY WORKS - SOUTH PLANT  
GENERAL CHEMICAL LLC  
CLAYMONT, DELAWARE**

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**RFI PHASE II REPORT  
DELAWARE VALLEY WORKS - SOUTH PLANT  
CLAYMONT, DELAWARE  
GENERAL CHEMICAL LLC**

**1.0 INTRODUCTION**

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Cummings/Riter Consultants, Inc. (Cummings/Riter) and MACTEC Engineering and Consulting, Inc. (MACTEC) have prepared this report to present the activities and results for data collected as part of the revised Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Phase II scope of work for the South Plant of what was previously known as the General Chemical LLC (General Chemical) Delaware Valley Works Facility, located in Claymont, Delaware (Figure 1-1). The RFI Phase II Work Plan (Work Plan) (Cummings/Riter and MACTEC, 2006) was prepared to satisfy the continued requirements of the Initial Administrative Order (IAO) (Docket No. RCRA-3-089CA) issued by the U.S. Environmental Protection Agency (USEPA), Region III to General Chemical, effective October 11, 2000.

**1.1 RFI INVESTIGATION STATUS**

As the initial technical requirement under the IAO, General Chemical submitted an RFI Work Plan for the Delaware Valley Works Facility to USEPA on December 10, 2000. On October 11, 2002, the RFI Work Plan was conditionally approved by USEPA. Field activities associated with the implementation of the RFI Work Plan were completed in July 2003. The results from these activities were evaluated and presented to the USEPA and the Delaware Department of Natural Resources and Environmental Control (DNREC) at a meeting on November 7, 2003 at DNREC's offices. The presentation of the results also included recommendations for Phase II RFI activities, including those related to the shutdown of the South Plant. The results and proposed recommendations for Phase II RFI activities were presented in a document entitled "Summary of Presentation Items, General Chemical Corporation, Delaware Valley Works Facility, Claymont, Delaware, November 11, 2003" (Data Summary Report).

General Chemical received comments from USEPA on the Data Summary Report on December 9, 2004. On January 27, 2005, General Chemical and Honeywell International, Inc. (Honeywell) met with USEPA and DNREC to discuss the comments. As agreed to during the meeting, in a letter dated March 31, 2005, General Chemical provided written responses to the December 2, 2004 technical review comment letter.

In a letter from USEPA dated June 28, 2005 and received by General Chemical on July 8, 2005, USEPA and DNREC provided an evaluation of the responses to comments in General Chemical's March 31, 2005 letter. USEPA agreed that the next step in the RFI process was the development of a draft Phase II RFI work plan to supplement the field investigation work completed to date. In addition, it was agreed that the draft Phase II RFI work plan would collectively address USEPA's technical review comments developed for the Data Summary Report and those documented in the enclosure to their June 28, 2005 letter.

In a letter dated April 11, 2006, USEPA and DNREC provided technical review comments on the draft RFI Phase II Work Plan dated September 16, 2005. General Chemical provided responses to USEPA's technical review comments in a letter dated June 16, 2006. In a letter dated September 7, 2006, USEPA and DNREC provided a technical evaluation of General Chemical's response. Following subsequent discussions between the parties, a letter dated September 14, 2006 from USEPA clarified Item No. 2 in their September 7, 2006 letter, and e-mail correspondences further addressed analytical and ecological risk assessment requirements. The RFI Phase II Work Plan (hereafter referred to as the Phase II Work Plan) was subsequently revised and submitted on October 27, 2006. Copies of the above-referenced correspondence was provided in Appendices A and B of the final Phase II Work Plan.

The Phase II Work Plan presented the proposed Phase II field investigations, a discussion of data evaluation and reporting activities, and a schedule for implementation related to additional soil and groundwater assessment activities for the South Plant (Figure 2-2). These activities were consistent with the recommendations made in the Data Summary Report and subsequent comment/response correspondence with the USEPA.



## **1.2 PROJECT AND REPORT ORGANIZATION**

The soil-related assessment activities as described in the Phase II Work Plan were conducted by Cummings/Riter and the groundwater-related assessment activities described in the Phase II Work Plan were conducted by MACTEC. A summary of the RFI Phase II soil assessment activities and results are presented in Section 2.0. Section 3.0 summarizes the RFI Phase II groundwater assessment field activities and results. Section 4.0 presents a summary of the conclusions and recommendations based on the RFI Phase I and Phase II activities.

## 2.0 RFI PHASE II SOIL ASSESSMENT

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The RFI Phase II scope of work for soils focused on additional activities at specific Solid Waste Management Units (SWMUs) addressed during the initial phase of the RFI and additional SWMUs/Areas of Concern (AOCs) identified following the shutdown of the South Plant. SWMUs/AOCs addressed by the RFI Phase II soil assessment included the following:

- SWMU 1 - Former North Phosphoric Acid Pond,
- SWMU 3 - Former Red Mud Slurry Pond A,
- SWMU 5 - Former Spar Building Storage Area,
- SWMU 33 - Former Spray Pond Area,
- SWMU 34 - Former Waste Oil Storage Pad,
- SWMU 35 - Former Hazardous Waste Storage Pad,
- SWMU 36 - Former Debris Staging Area/Alum Plant Area,
- AOC 5 - Former Sulfur Storage Tank Spill,
- AOC 6 - Former Aboveground Fuel Storage Tank A,
- AOC 7 - Former Sulfuric Acid Plant - Unpaved Area,
- AOC 8 - Former Spent Sulfuric Acid Loading/Unloading Area Sumps,
- AOC 9 - Former Spent Sulfuric Acid Storage Area Sumps,
- AOC 10 - Former Sulfuric Acid Plant Area - Acid and Caustic Storage Tank Area Sumps,
- AOC 11 - Former Contact Sulfuric Acid Plant Area A - Aboveground Storage Tank (AST) Area Sumps and Building Sump,
- AOC 12 - Former Contact Sulfuric Acid Plant Area B - Acid Storage Tank Area Sumps,
- AOC 13 - Former Photosalts Plant Storage Tank Area Sumps,
- AOC 14 - Former Sulfuric Acid Storage Tank Area Sump,
- AOC 15 - Former Acid Loading/Unloading Area Sumps, and
- AOC 16 - Former Aboveground Fuel Oil Storage Tank C.

The locations of these SWMUs/AOCs are shown on Figure 2-2. A summary of the RFI Phase II soil assessment activities is presented in Sections 2.1 and 2.2. A summary of conclusions and recommendations regarding the RFI Phase II soil results is presented in Section 2.3.

## **2.1 SUMMARY OF FIELD INVESTIGATIONS**

Field methodologies and laboratory analyses were implemented in accordance with the approved Data Collection Quality Assurance Project Plan prepared as part of the original RFI Work Plan submittal. Tables 1 and 2 provide a summary of the RFI Phase II scope of work. These tables include the number of samples collected at each SWMU/AOC, sample depths, sample identifications, analytical program, and any deviations from the proposed plan.

### **2.1.1 Soil Sampling Procedures**

Cummings/Riter collected soil samples at various locations across the South Plant property either manually (trowels and/or hand augers) or using direct-push techniques (DPT) utilizing a truck-mounted Geoprobe®. Manual soil samples were collected using disposable, plastic trowels or clean, stainless-steel hand augers. DPT samples were collected with the Geoprobe® using two-inch diameter, stainless-steel macrocore samplers, and new acetate liners. The samples were collected continuously from ground surface to specified depths as outlined in the Phase II Work Plan. For soil sample locations covered by concrete (e.g., sumps areas), concrete coring was completed to access underlying soil for sampling.

Soil samples submitted for laboratory analysis were collected from specific depths and were logged in the field. Samples for volatile organic compound (VOC) analysis were collected in accordance with USEPA Method 5035 using TerraCore™ samplers. These samplers allow for the collection of sample fractions that can be analyzed by low level and high level methods. Samples to be analyzed for the remaining parameters were collected by completely filling one or more 500-milliliter (ml) widemouth glass jar, as appropriate. Geoprobe® borings were backfilled to ground surface with soil removed from the boring and/or bentonite pellets. Also, borings advanced through asphalt or concrete were patched following sampling. Soil sample collection reports are included as Appendix A.

### **2.1.2 Quality Assurance/Quality Control Sampling**

In addition to the soil samples, Cummings/Riter collected quality assurance samples as a measure of analytical precision and as a check on the effectiveness of equipment

decontamination procedures. One aqueous trip blank sample was submitted for analysis of VOCs. Duplicates, matrix spike/matrix spike duplicates, and field equipment blanks were collected and submitted to the laboratory for analysis of specified parameters.

### **2.1.3 Decontamination**

Decontamination of equipment used for sampling was carefully performed to minimize any possibility of cross-contamination through the use of tools and equipment. Sampling equipment was decontaminated prior to initial use. An area on site was designated for decontaminating equipment and materials. Decontamination residues were managed and disposed of in accordance with the approved Data Collection Quality Assurance Project Plan.

Small tools and other apparatus that were used for sampling included trowels, hand augers, spoons, and macrocore samplers. This equipment was decontaminated prior to their initial use and between sampling locations. The equipment was washed in a detergent and water solution (e.g., Alconox or Liquinox) and rinsed with tap water to remove particulates. The equipment was then sprayed with methanol followed by distilled or deionized water, and then allowed to air dry. Following decontamination, the equipment (if not used immediately) was wrapped in aluminum foil to prevent possible contamination prior to next use.

### **2.1.4 Surveying**

A licensed surveyor registered in the State of Delaware (ND Remy and Associates) surveyed each soil sampling point location. Each soil sampling location was staked and labeled in the field to provide proper guidance for the surveyor. The horizontal and vertical position of each location was referenced to the existing facility grid which is based on the Delaware State Plane Meridian, North American Datum 1927.

## **2.2 SUMMARY OF SOIL ASSESSMENT RESULTS**

This section provides a summary of the soil assessment results. Data collected during the Phase II RFI were evaluated to ensure that they met the scope of work objectives and provide adequate information to evaluate existing and potential future human health risks and impact to groundwater quality.

Soil samples were analyzed for one or more of the following parameters (depending on the specific SWMU/AOC): VOCs, semivolatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), Appendix IX metals or select metals, polychlorinated biphenyls (PCBs), and pH. In addition, soil samples collected from SWMU 5 were analyzed for nine additional organic compounds including seven VOCs (1,4-dioxane, 2-methyl-1-propanol, acetonitrile, acrolein, dichlorofluoromethane, methacrylonitrile, and propionitrile) and two SVOCs (kepone and 4-nitroquinoline-1-oxide). The sample results for these parameters in soil samples collected during the RFI Phase I were rejected following data validation. These compounds were analyzed to determine if they were additional potential constituents of concern for SWMU 5.

In accordance with the Phase II Work Plan, soil analytical data were compared with screening criteria including USEPA Region III industrial risk-based concentrations (RBCs) as well as USEPA Region III's soil-to-groundwater pathway  $10^{-6}$  risk-based soil screening level (SSL), Dilution Attenuation Factor = 20. As requested by USEPA, the tables summarizing the soil analytical results also include USEPA Region III residential RBCs for comparison purposes. Data validation was completed on 100 percent of the samples, and appropriate data qualifiers are presented in the data tables. Laboratory analysis reports for soil samples are provided in Appendix B-1. Data validation summaries are included in Appendix C-1. Quality assurance/quality control (QA/QC) sample results are presented in Table 2-3.

The following subsections present a background description for each of the SWMUs/AOCs that were included in the RFI Phase II soil assessment, a summary of the scope of work, and a summary of the analytical results. Tables 2-1 and 2-3 provide summaries of the characterization program including the number of samples collected at each SWMU/AOC, sample depths, sample identifications, analytical program, and any deviations from the proposed plan. SWMU/AOC locations and RFI Phase II soil sampling locations are shown on Figure 2-3.

### **2.2.1 SWMU 1 - Former North Phosphoric Acid Pond**

SWMU 1 is located in the southeastern portion of the South Plant (Figure 2-2). A detailed description of the unit was provided in the May 2002 RFI Work Plan.

Photographs are included in Appendix D. The basin was in use from about 1960 to 1984

and used initially to store phosphoric acid, and then as a settling basin within the National Pollutant Discharge Elimination System (NPDES) effluent system for waste water collection/storage of acid-based processes. The inside dimensions of the unit were approximately 50 feet by 60 feet, and the embankments of the unit were approximately 6 feet high. The unit was reportedly constructed with a liner system consisting of compacted clay soil overlain by several layers of asphalt and burlap. The pond was reportedly closed by backfilling with on-site fill and is currently covered with gravel.

Two surface soil samples (below the gravel layer) were collected at this SWMU during RFI Phase I activities. To evaluate subsurface soil conditions for this SWMU, RFI Phase II activities included the collection of four soil samples at two locations (Figure 2-3). Continuous soil samples were collected from ground surface to the water table. At each sample location, a soil sample from the clay liner and a soil sample from below the liner were to be collected. However, the liner was only encountered at one location (SWMU 1-2). Groundwater was encountered prior to encountering the clay liner at the second location; therefore, the soil samples were collected within the approximate 3- to 6-foot depth intervals of approximately 3 to 6 feet below ground surface (bgs). The soil samples were analyzed for Appendix IX metals and pH.

In the four subsurface soil samples collected at SWMU 1, concentrations were above screening criteria for the following parameters: antimony, arsenic, chromium, lead, and thallium. The following list summarizes these exceedances:

- The concentrations reported for antimony in two of the samples (14.1 milligrams per kilogram [mg/kg] and 15.0 mg/kg) slightly exceeded the corresponding SSL (13 mg/kg).
- The concentrations reported for arsenic in all four samples (ranging from 76.1 to 158 mg/kg) exceeded the corresponding industrial risk-based concentration (RBC) (1.9 mg/kg) and SSL (0.026 mg/kg).
- Two of the samples detected chromium at concentrations (44.4 mg/kg and 50.0 mg/kg) slightly above the corresponding SSL (42 mg/kg).
- An exceedance for lead was detected in one sample at a concentration of 1,060 mg/kg which is above the corresponding industrial RBC (800 mg/kg).

- The concentration reported for thallium in one of the samples (4.19 mg/kg) was slightly above the corresponding SSL (3.6 mg/kg).

Table 2-4 summarizes the results of the soil samples collected in SWMU 1 during the Phase I and Phase II RFI. Figures 2-4 and 2-5 illustrate the distribution of arsenic and lead concentrations across the South Plant, including SWMU-1. Exceedances for antimony and thallium across the South Plant are summarized on Figure 2-7, including SWMU-1.

### **2.2.2 SWMU 3 - Former Red Mud Slurry Pond A**

The former Red Mud Slurry Pond A is located in the west central portion of the South Plant (Figure 2-2). Photographs are included in Appendix D. A detailed description of the unit was provided in the Phase I RFI Work Plan. The unit was reportedly approximately 30 feet by 100 feet and approximately 5.5 feet deep. It was constructed of compacted soil and used to store iron oxide that originated from the burning of pyritic ores.

RFI Phase II activities for this SWMU included the collection of continuous soil samples from ground surface to the water table using a Geoprobe<sup>®</sup> at two locations. Two soil samples were collected from each boring for a total of four samples. The samples were to be collected from the compacted soil liner and from below the liner. However, groundwater was encountered at a depth of approximately 6.5 feet below ground surface (bgs) which was prior to encountering the clay liner at either location. Therefore, samples were collected at intervals above this depth at each location. Iron oxide material was encountered throughout the depth of each boring. Each soil sample was analyzed for Appendix IX metals and pH. The RFI Phase II sample locations are shown on Figure 2-3.

In the four soil samples collected at this SWMU, concentrations were above screening criteria for the following parameters: arsenic, selenium, and chromium. The following list summarizes these exceedances:

- The concentrations reported for arsenic in all four samples (ranging from 77.6 to 204 mg/kg) exceeded the corresponding industrial RBC (1.9 mg/kg) and SSL (0.026 mg/kg).

- Selenium was detected in all four samples at concentrations ranging from 191 to 312 mg/kg which are above this parameter's corresponding SSL (19 mg/kg).
- Chromium was detected in all four samples at concentrations ranging from 65.2 to 89.1 mg/kg which exceed the corresponding SSL (42 mg/kg).

Table 2-5 summarizes the results of the soil samples collected during the RFI Phase II activities. Figure 2-4 illustrates the distribution of arsenic concentrations at this SWMU. Selenium and chromium exceedances are presented on Figure 2-7.

### **2.2.3 SWMU 5 - Former Spar Building Storage Area**

The former Spar Building Storage Area is located at the southeastern portion of the South Plant (Figure 2-2). Photographs are included in Appendix D. The area was used to store miscellaneous plant wastes, construction materials, and non-hazardous off-grade product primarily in drums. During its use, the storage area had an asphalt base. After it became inactive, fill material and gravel were placed over the entire area.

#### **2.2.3.1 Phase I RFI Soil Sampling**

Phase I RFI activities focused initially on determining the integrity of the asphalt paving by using a backhoe to displace the overlying debris. The asphalt paving was identified approximately 1.0 to 1.5 feet bgs and in a deteriorated condition. Therefore, four soil samples were collected at four different locations immediately beneath the asphalt pavement (Figure 2-3). Because of the depth of the overlying debris, RFI Phase I samples were actually collected from a depth of approximately 1.5 to 2.0 feet bgs at each location.

Samples were analyzed for VOCs, SVOCs, Appendix IX metals, mercury, and pH. RFI Phase I soil sample results are summarized in Table 2-6. The constituents of potential concern identified in the samples included arsenic, mercury, lead, and PAHs. In addition, laboratory results for nine organic compounds in soil samples collected during the RFI Phase I were rejected following data validation. These organic compounds included seven VOCs (1,4-dioxane, 2-methyl-1-propanol, acetonitrile, acrolein, dichlorofluoromethane, methacrylonitrile, and propionitrile) and two SVOCs compounds (kepone and 4-nitroquinoline-1-oxide).



### 2.2.3.2 Phase II RFI Soil Sampling

Phase II RFI activities at this SWMU included the collection of 43 additional soil samples from 16 locations to determine the source and extent of the constituents of potential concern and evaluate potential impacts from surface water runoff in the area. The soil sampling program at SWMU 5 included the following:

- Collection of four surface soil samples (0- to 6-inch depth interval) at the RFI Phase I sampling locations (SWMU 5-1 through SWMU 5-4). The results of these surface soil samples provided data for evaluating the potential soil-to-industrial-worker exposure pathway, and were analyzed for arsenic, lead, mercury, PAHs, and the nine additional organic compounds.
- Collection of four deeper soil samples (1.5 to 2.0 feet bgs) from the same approximate location and depth interval as the RFI Phase I sampling locations (SWMU 5-1 through SWMU 5-4), and analyzed for the additional nine organic compounds.
- Collection of additional soil samples representing the 4- to 6-foot depth interval at the RFI Phase I sample locations. Samples from this interval were collected at Sample Locations SWMU 5-3 and SWMU 5-4. These samples were analyzed for arsenic, lead, mercury, and PAHs. Samples from this depth interval could not be collected at the SWMU 5-1 and SWMU 5-2 locations because Geoprobe® refusal was encountered prior to reaching the target depth.
- Collection of 12 additional surface soil samples to define the lateral extent of constituents of potential concern in the vicinity of SWMU 5 (identified as SWMU 5-5 through SWMU 5-16). The 12 sampling locations were spatially distributed around the general perimeter of the SWMU, as well as within the area between the railroad spur and SWMU 9. These samples were analyzed for arsenic, lead, mercury, and PAHs.
- Collection of two subsurface soil samples at each of the 12 additional surface soil sampling locations representing the 2- to 4- and 4- to 6-foot depth intervals. Chemical analyses of these subsurface soil sample locations were completed where overlying soil sample results for arsenic, lead, mercury, and/or individual PAHs were detected above SSLs or industrial RBCs. The chemical analyses for these samples were performed only for the specific constituents detected above an associated standard. Several PAHs exceeded their respective standards but deeper samples were not analyzed since the sample

exceeded laboratory holding times for this analysis. However, as discussed in the sample result section for this SWMU and Section 2.3, not analyzing these additional samples did not affect the conclusions regarding characterization. Also, at Borings SWMU5-7 and SWMU5-15, samples were not collected from both depth intervals. Refusal was encountered at 4 feet bgs in Boring SWMU5-7 and at 2 feet bgs in Boring SWMU5-15.

- If any of the nine additional organic constituents were detected in the shallow soil samples at concentrations above applicable screening criteria, additional soil samples were to be collected and analyzed to further define the extent of these compounds. None of these compounds were detected.

Table 2-2 summarizes the samples collected at SWMU 5, their depth, sample identification, and parameters analyzed. Additionally, RFI Phase II soil sampling locations for SWMU 5 are shown on Figure 2-3.

#### **2.2.3.3 SWMU 5 Sample Results**

A total of 43 samples were collected from the SWMU 5 area. For soil samples collected at this SWMU, concentrations were above screening criteria for the following parameters: arsenic, lead, naphthalene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, and ideno(1,2,3-cd)pyrene. The following list summarizes these exceedances:

- Arsenic was detected in each of the 39 samples analyzed for this parameter. Detections ranged from 6.79 to 957 mg/kg which each exceeded the corresponding industrial RBC (1.9 mg/kg) and SSL (0.026 mg/kg).
- Lead exceedances were detected in 21 of the 39 samples at concentrations ranging from 834 to 14,100 mg/kg which are above the corresponding industrial RBC (800 mg/kg).
- Naphthalene exceedances were detected in two of the 17 samples (580 µg/kg and 620 µg/kg) above the SSL of 150 µg/kg.
- Benzo(a)anthracene exceedances were detected in 14 of the 19 samples analyzed for this compound at concentrations ranging from

560 to 10,000 micrograms per kilogram ( $\mu\text{g/kg}$ ) which are above the corresponding SSL ( $480 \mu\text{g/kg}$ ) and/or industrial RBC ( $3,900 \mu\text{g/kg}$ ).

- Exceedances of benzo(b)fluoranthene were detected in 7 of the 22 samples analyzed for this compound at concentrations ranging from 2,400 to 11,000  $\mu\text{g/kg}$  which exceed one or both of the corresponding SSL ( $1,500 \mu\text{g/kg}$ ) and industrial RBC ( $3,900 \mu\text{g/kg}$ ).
- Benzo(a)pyrene exceedances were detected in 29 of the 35 samples analyzed for this compound at concentrations ranging from 130 to 8,300  $\mu\text{g/kg}$  which are above the corresponding SSL ( $120 \mu\text{g/kg}$ ) and/or industrial RBC ( $390 \mu\text{g/kg}$ ).
- Exceedances of dibenz(a,h)anthracene were detected in 4 of the 22 samples analyzed for this compound at concentrations ranging from 530 to 1,200  $\mu\text{g/kg}$  which are above the corresponding SSL ( $460 \mu\text{g/kg}$ ) and industrial RBC ( $390 \mu\text{g/kg}$ ).
- Of the 19 samples analyzed for this parameter, one exceedance of ideno(1,2,3-cd)pyrene was detected at a concentration of 6,500  $\mu\text{g/kg}$  which exceeds the corresponding SSL ( $4,200 \mu\text{g/kg}$ ) and industrial RBC ( $3,900 \mu\text{g/kg}$ ).

Table 2-7 presents summaries of the soil sample analytical results for the samples collected in SWMU 5 during the RFI Phase II. Figures 2-4, 2-5, and 2-6 illustrate the distribution of arsenic, lead, and benzo(a)pyrene, respectively throughout the South Plant, including the SWMU 5 area. Exceedances for other parameters in the SWMU 5 area are shown on Figure 2-7.

#### **2.2.4 SWMU 33 - Former Spray Pond Area**

The former Spray Pond Area is located in the east-central portion of the South Plant (Figure 2-2). Photographs are included in Appendix D. This area was originally used in association with the plant's boiler system as a collection system for boiler blow-down water. Therefore, the residuals in the pond would have primarily contained metals such as magnesium, calcium, and sodium associated with water hardness and softness. The residuals may have also contained low levels of vanadium which was used as an oxygen scavenger, and possibly sulfites if they were used to scavenge the oxygen. Insurance maps indicate that at least as far back as 1970, the area was used for scrap metal storage

only, and therefore, the use of the spray pond for the boiler system was discontinued prior to that date. The use of this area was for a similar purpose at the time General Chemical bought the property in 1986. Specific details of its construction were not found in historical files. The surface area of the SWMU is currently paved, but does show areas of significant deterioration.

To characterize soil conditions associated with this SWMU, two samples were collected from one soil boring drilled in the approximate center of the unit. Continuous soil samples were collected from ground surface to the water table. Soil samples were collected from depth intervals of 1 to 4 feet bgs and 4 to 6 feet bgs. These samples were analyzed for Appendix IX VOCs, SVOCs, and metals. The sample location is shown on Figure 2-3.

Concentrations were above one or more of the screening criteria for the following parameters: arsenic, chromium, and tetrachloroethene (PCE). The following list summarizes these exceedances:

- The concentrations reported for arsenic in both samples (4.27 and 6.52 mg/kg) slightly exceeded the corresponding industrial RBC (1.9 mg/kg) and SSL (0.026 mg/kg).
- One chromium exceedance was detected in the shallow sample at this location at a concentration of 45.6 mg/kg which slightly exceeds the corresponding SSL (42 mg/kg).
- PCE was detected in both samples collected at this SWMU (at concentrations of 6 and 57 µg/kg which are slightly above this compound's corresponding SSL (4.7 µg/kg).

Table 2-8 summarizes the results of the soil samples collected during the Phase II RFI. Figure 2-4 illustrates the distribution of arsenic concentrations at this location and Figure 2-7 shows that chromium and PCE exceedances at this SWMU.

### **2.2.5 SWMU 34 - Former Waste Oil Storage Pad**

SWMU 34 is located in the south central portion of the South Plant (Figure 2-2). Photographs are included in Appendix D. This SWMU was constructed in the mid-1980s. It was used for the storage of 55-gallon drums of waste oil prior to off-site

disposal. The waste oil was primarily generated from vehicular, compressor, and blower maintenance/repair activities. There have been no documented releases associated with this SWMU. The former Waste Oil Storage Pad area is approximately 15 feet by 15 feet and paved. Adjacent areas along two sides of the pad are paved, and the other two sides are unpaved.

RFI Phase II activities included the collection of one surface soil sample (0- to 6-inch depth interval) from each unpaved side of the SWMU (total of two samples). Samples were collected using a hand auger and shovel. Each sample was collected below a surficial gravel layer. Samples were analyzed for VOCs, SVOCs, Appendix IX metals, and PCBs. Sample locations are shown on Figure 2-3.

Concentrations were above one or more of the screening criteria for the following parameters: arsenic, chromium, benzo(a)anthracene, benzo(a)pyrene, and PCB-1260.

The following list summarizes these exceedances:

- The concentrations reported for arsenic in both samples (2.13 and 50.6 mg/kg) exceeded the corresponding industrial RBC (1.9 mg/kg) and SSL (0.026 mg/kg).
- Chromium was detected in both of the samples at concentrations of 135 mg/kg and 121 mg/kg, which exceed the corresponding SSL (42 mg/kg).
- Benzo(a)anthracene was detected in one of the samples at a concentration of 520 µg/kg, which is slightly above the corresponding SSL (480 µg/kg).
- Benzo(a)pyrene exceedances were detected in both samples at concentrations of 410 and 470 µg/kg which are above both of the corresponding SSL (120 µg/kg) and its industrial RBC (390 µg/kg).
- PCB-1260 was detected in one of the samples at a concentration of 1,500 µg/kg which is slightly above the corresponding industrial RBC of 1,400 µg/kg.

Table 2-8 summarizes the results of the soil samples collected during the Phase II RFI activities. Figures 2-4 and 2-6 illustrate the arsenic and benzo(a)pyrene distribution,

respectively, at this SWMU. Chromium, benzo(a)anthracene, and PCB-1260 exceedances are shown on Figure 2-7.

#### **2.2.6 SWMU 35 - Former Hazardous Waste Storage Pad**

SWMU 35 is located in the southeastern portion of the South Plant (Figure 2-2).

Photographs are included in Appendix D. The former Hazardous Waste Storage Pad was constructed in the mid-1980s and covers an area approximately 30 feet by 50 feet. The pad was paved at the time of its initial construction and repaved in the 1990s. Hazardous waste stored on the pad primarily consisted of waste oils and miscellaneous chemicals. Wastes were primarily contained within 55-gallon drums. There have been no documented releases associated with this SWMU.

RFI Phase II activities included the collection of four surface samples (0- to 6-inch depth interval); one centrally located along each side of the pad (total of four samples).

Samples were collected using a hand auger. Each sample was analyzed for VOCs, SVOCs, Appendix IX metals, and PCBs. Sample locations are shown on Figure 2-3.

Concentrations were above screening criteria for the following parameters: arsenic, chromium, benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, and PCB-1254. The following list summarizes these exceedances:

- The concentrations reported for arsenic in all four samples from this SWMU (ranging from 9.69 to 46.2 mg/kg) exceeded the corresponding industrial RBC (1.9 mg/kg) and SSL (0.026 mg/kg).
- Chromium was detected in each of the samples collected from this SWMU at concentrations ranging from 63.8 to 85.4 mg/kg which exceed the corresponding SSL (42 mg/kg).
- Benzo(a)anthracene was detected in all four samples at concentrations ranging from 500 to 4,700 µg/kg which are above the SSL (480 µg/kg) and/or industrial RBC (3,900 µg/kg).
- Benzo(b)fluoranthene exceedances were detected in three of four samples at concentrations ranging from 1,900 to 6,000 µg/kg which are above the corresponding SSL (1,500 µg/kg) and/or industrial RBC (3,900 µg/kg).

- Benzo(a)pyrene was detected in all four samples at concentrations ranging from 520 to 4,800  $\mu\text{g/kg}$  which are above corresponding SSL (120  $\mu\text{g/kg}$ ) and/or industrial RBC (390  $\mu\text{g/kg}$ ).
- Exceedances of dibenz(a,h)anthracene were detected in two of the four samples at concentrations of 420 and 860  $\mu\text{g/kg}$  which are above the corresponding industrial RBC (390  $\mu\text{g/kg}$ ) and/or SSL (460  $\mu\text{g/kg}$ ).
- PCB-1254 exceedances were detected in two of the four samples collected at concentrations of 2,400 to 8,100  $\mu\text{g/kg}$  which are above the corresponding SSL (1,100  $\mu\text{g/kg}$ ) and industrial RBC (1,400  $\mu\text{g/kg}$ ).

Table 2-9 summarizes the results of the soil samples collected during the Phase II RFI. Figures 2-4 and 2-6 illustrate the distribution of arsenic and benzo(a)pyrene exceedances at SWMU 35. Figure 2-7 shows the location of exceedances for the other parameters at this SWMU.

#### **2.2.7 SWMU 36 - Former Debris Staging Area/Alum Plant Area**

The Debris Staging Area was formerly located adjacent to and south of the former Alum Plant (Figure 2-2). Photographs are included in Appendix D. The Alum Plant made both liquid and dry alum (aluminum sulfate) from bauxite and sulfuric acid, or hydrate and sulfuric acid. Based on an inspection of this staging area prior to submitting the "Data Summary Report" in November 2003, additional work was not proposed for this area as noted in that report. As part of plant decontamination activities, the Alum Plant and associated structures were razed. As a result of these activities, several feet of fill material from the demolition of the buildings currently exists across the footprint of the former structures. The footprint of this area is approximately 200 feet by 350 feet, and the area is shown on Figure 2-2. Concrete pavement (i.e., floors, footers, pads) remain in place beneath the fill material. Based on the historical operations at the former Alum Plant, it is possible that constituents within the fill material are at levels of potential concern.

Phase II RFI soil samples were collected to evaluate surface soil quality across this area. A total of eight surface soil samples (0- to 6-inch depth interval) were collected across the area. Each sample was analyzed for Appendix IX metals and pH. Sample locations are shown on Figure 2-3.

Concentrations were above screening criteria for arsenic and chromium at SWMU 36. The following list summarizes these exceedances:

- The concentrations reported for arsenic in all eight samples from SWMU 36 (ranging from 3.21 to 20.8 mg/kg) exceeded the corresponding industrial RBC (1.9 mg/kg) and SSL (0.026 mg/kg).
- Chromium exceedances were detected in four of the eight samples collected from this SWMU at concentrations ranging from 43.7 to 146 mg/kg which exceed the corresponding SSL (42 mg/kg).

Table 2-10 summarizes the results of the soil samples collected during the Phase II RFI. Figure 2-4 shows the distribution of arsenic at SWMU 36 and chromium exceedances are illustrated on Figure 2-7.

#### **2.2.8 AOC 5 - Former Sulfur Storage Tank Spill**

In February 2002, approximately 1,500 tons of molten sulfur spilled onto the ground from a breach in the storage tank. Molten sulfur solidifies relatively quickly below a temperature less than 250 degrees F (°F) and, therefore, the extent of the spill was limited once the material was exposed to the atmosphere. The location and extent of the spill is illustrated on Figure 2-2. Photographs of the area are provided in Appendix D. The spill covered an area of approximately 100 feet by 150 feet.

Remediation activities were implemented immediately following the spill and coordinated with DNREC. Because of its distinctive yellow color, the extent of waste/soil removal was based on visual observations in the field. Approximately 4,000 tons of sulfur/soil were disposed off site. Recent decommissioning activities included the removal of sulfur from the tank and disposal of the tank off site.

A total of six surface soil samples were collected within the area of the tank and associated spill. Samples were collected using a hand auger and were analyzed for Appendix IX metals and pH. Sample locations are shown on Figure 2-3.

Concentrations were above screening criteria for arsenic and chromium. The following list summarizes these exceedances:



- The concentrations reported for arsenic in all six samples from AOC 5 (ranging from 2.25 to 28.8 mg/kg) exceeded both the corresponding industrial RBC (1.9 mg/kg) and SSL (0.026 mg/kg).
- A chromium exceedance was detected in one of the six samples collected from AOC 5 at a concentration of 54.1 mg/kg which slightly exceeds the corresponding SSL (42 mg/kg).

Table 2-11 summarizes the results of the soil samples collected during the Phase II RFI, while Figures 2-4 and 2-7 show the distribution of arsenic and chromium exceedances, respectively, at this AOC.

### **2.2.9 AOC 6 - FORMER ABOVEGROUND FUEL STORAGE TANK A**

The location of this AST is shown on Figure 2-2. Photographs are included in Appendix D. The tank was 24 feet in diameter and 16 feet in height and had an approximate capacity of 54,000 gallons. The AST contained Fuel Oil No. 6 used in operations associated with the power house. As part of decommissioning activities, the tank contents were removed and the tank was cleaned and properly disposed off site. The concrete containment was cleaned by pressure washing, and holes were drilled near the base of the containment wall to prevent the collection of precipitation. No breaches in the containment were observed during decommissioning activities. Incidental spills within the secondary containment structure potentially occurred during past operations.

During the Phase II RFI activities, a thorough inspection of the containment structure was completed. The concrete was found to be in good condition and therefore, two locations were selected randomly for the collection of soil samples beneath the concrete containment structure. The concrete was cored and soil samples were collected from the 0- to 6-inch and 6- to 12-inch depth intervals using a hand auger. Samples were analyzed for Appendix IX metals, VOCs, and SVOCs. Sample locations are shown on Figure 2-3.

Concentrations were above screening criteria for arsenic and thallium. The following list summarizes these exceedances:

- The concentrations reported for arsenic in the four samples (ranging from 7.26 to 26.5 mg/kg) exceeded the corresponding industrial RBC (1.9 mg/kg) and SSL (0.026 mg/kg).

- A thallium exceedance was detected in one of the four samples at a concentration of 3.62 mg/kg which is slightly above the corresponding SSL (3.6 mg/kg).

Table 2-12 summarizes the results of the soil samples collected during the Phase II RFI. Figures 2-4 and 2-7 illustrate the distribution of arsenic and thallium exceedances, respectively, at AOC 6.

#### **2.2.10 AOC 7 - Former Sulfuric Acid Plant - Unpaved Area**

AOC 7 is located within the former Sulfuric Acid Plant Area (Figure 2-2). Photographs are included in Appendix D. The area represented by AOC 7 consists of an unpaved area beneath and immediately adjacent to the boiler burner portion of the sulfuric acid plant. Primary materials managed within these operations were spent sulfuric acid, sulfur, and fuel. The area is covered with large gravel approximately one foot in depth and the height of access in most areas is 5 feet or less. Incidental spillage/leakage from operations may have impacted soils within this area.

A total of six surface soil samples (0- to 6-inch depth interval) were collected within the AOC 7 area. Prior to sampling, the surface gravel was removed down to native soil or after encountering fill material consisting primarily of sand, silt, and/or clay-sized particles. Samples were collected using a hand auger and shovel, and were analyzed for Appendix IX metals, VOCs, SVOCs, and pH. Sampling locations are shown on Figure 2-3.

Concentrations in one or more of the six soil samples were above screening criteria for the following parameters: arsenic, chromium, lead, selenium, 1,4-dichlorobenzene, and benzo(a)pyrene. The following list summarizes these exceedances:

- The concentrations reported for arsenic in all six samples (ranging from 10.6 to 133 mg/kg) exceeded the corresponding industrial RBC (1.9 mg/kg) and SSL (0.026 mg/kg).
- Chromium exceedances were detected in five of the six samples at concentrations from 46.2 to 90.8 mg/kg which exceed the corresponding SSL (42 mg/kg).

- A lead exceedance was detected in one of six samples at a concentration of 1,280 mg/kg which is above the corresponding industrial RBC (800 mg/kg).
- Selenium exceedances were detected in two of the six samples at concentrations of 92.5 and 179 mg/kg which are above the corresponding SSL (19 mg/kg).
- One of six samples had a concentration of 1,4-dichlorobenzene at 420 µg/kg which exceeds the corresponding SSL (7.1 µg/kg).
- Benzo(a)pyrene exceedances were detected in four of the six samples at concentrations ranging from 140 to 320 µg/kg which exceed the SSL of 120 µg/kg.

Table 2-13 summarizes the results of the soil samples collected during the Phase II RFI. Figures 2-4, 2-5, and 2-6 illustrate the distribution of arsenic, lead, and benzo(a)pyrene exceedances at this AOC. Figure 2-7 shows exceedances of the other parameters.

#### **2.2.11 AOC 8 - Former Spent Sulfuric Acid Loading/Unloading Area Sumps**

The location of AOC 8 is shown on Figure 2-2. Photographs are included in Appendix D. This AOC consisted of several ASTs that contained spent sulfuric acid. Because of the source of this acid (oil refinery), the spent acid may contain low levels of benzene, toluene, ethylbenzene, and xylene and other hydrocarbons. This material was used in the manufacturing of sulfuric acid. The tank area is surrounded by concrete containment, and adjacent areas are paved with concrete. One sump was identified within the tank containment area. The sump is approximately three feet deep and lined with acid resistant materials. The acid resistant material in some areas of the sump was deteriorated.

As part of RFI Phase II activities, the sump was inspected. Prior to the inspection, sediment and water that had accumulated in the sump were removed using a vacuum truck. An attempt was made to collect a soil sample from beneath the sump. However, after coring through the base of the sump, perched water was encountered which entered the sump. An attempt was made to pump the water out of the sump, but it could not be

dewatered to the point that would allow sampling. This situation was discussed with the USEPA and DNREC who concurred with the decision not to collect a soil sample at this location.

#### **2.2.12 AOC 9 - Former Spent Sulfuric Acid Storage Area Sumps**

The location of AOC 9 is shown on Figure 2-2. Photographs are included in Appendix D. This AOC consists of an AST used for the storage of spent sulfuric acid. This material was used in the manufacturing of sulfuric acid. The tank is surrounded by concrete containment, and adjacent areas are paved with concrete. Two sumps are present within the tank containment area. The sumps are approximately 3 feet deep and lined with acid-resistant materials.

As part of RFI Phase II activities, the sumps were inspected. Prior to the inspection, sediment and water accumulated in the sump were removed using a vacuum truck. For both sumps, the acid-resistant material indicated some deterioration. The sump used primarily for keeping the containment area dewatered was selected for sampling. Following coring through the base of the sump, one surface soil sample was collected beneath the base of the sump. The sample was analyzed for Appendix IX metals, VOCs, SVOCs, and pH. The corehole was plugged following sample collection.

Concentrations were found above screening criteria for arsenic and lead. Arsenic was detected at a concentration of 3.55 mg/kg which exceeded the corresponding industrial RBC (1.9 mg/kg) and SSL (0.026 mg/kg). Lead was detected at a concentration of 1,750 mg/kg which is above the corresponding industrial RBC (800 mg/kg). Table 2-14 summarizes the results of the soil samples collected during the Phase II RFI. Figures 2-4 and 2-5 show the arsenic and lead concentrations (respectively) relative to other site areas.

#### **2.2.13 AOC 10 - Former Sulfuric Acid Plant Area - Acid and Caustic Storage Tank Area Sumps**

The location of AOC 10 is shown on Figure 2-2. Photographs are included in Appendix D. This AOC consisted of separate AST areas; one for the former storage of weak acid and the second for the former storage of caustic material. These materials were used in the manufacturing of sulfuric acid. Both tank areas are surrounded by

concrete containment, and adjacent areas are paved with concrete. One sump is located within each of the tank areas. The sumps are approximately 3 feet deep and lined with acid resistant materials.

Prior to sump inspection, water within the containment area and water and sediment were removed from the sumps using a vacuum truck. The sumps were then inspected. Some deterioration of the liner materials was noted. Following coring through the base of each sump, a soil sample was collected and analyzed for Appendix IX metals and pH.

Concentrations were above screening criteria for the following parameters: arsenic, antimony, lead, and thallium. The following list summarizes these exceedances:

- The concentrations reported for arsenic in both samples (37.4 and 158 mg/kg) exceeded the corresponding industrial RBC (1.9 mg/kg) and SSL (0.026 mg/kg).
- One antimony detection (at a concentration of 31.8 mg/kg) exceeded the corresponding SSL (13 mg/kg).
- One lead exceedance was detected in one of the samples at a concentration of 950 mg/kg which is slightly above the corresponding industrial RBC (800 mg/kg).
- Thallium exceedances were detected in both samples at concentrations of 4.96 and 5.60 mg/kg which are slightly above the corresponding SSL (3.6 mg/kg).

Table 2-14 summarizes the results of the soil samples collected during the Phase II RFI. Figures 2-4 and 2-5 illustrate the distribution of arsenic and lead at AOC 10.

#### **2.2.14 AOC 11 - Former Contact Sulfuric Acid Plant Area A - AST Area Sumps and Building Sump**

The location of AOC 11 is shown on Figure 2-2. Photographs are included in Appendix D. This AOC consists of two separate areas within the former Contact Sulfuric Acid Plant Area A. One area is located along the western side of the plant and consists of a series of AST areas containing precipitators and dryers used in the manufacturing of

sulfuric acid. Each of the tank areas is surrounded by concrete containment. Adjacent areas are also concrete paved. One or more sumps are present within the tank areas. The sumps are approximately 3 feet deep and lined with acid-resistant materials.

The second distinct area of AOC 11 is a sump within the main Contact Sulfuric Acid Plant building at the location shown on Figure 2-2. The sump collected fluids (primarily acidic) from various operations within the building. The sump is approximately 4 feet by 4 feet and 6 feet deep.

Following decommissioning activities, these sumps were filled with limestone gravel to neutralize any residual acid. Based on their current status and with concurrence from USEPA and DNREC, no soil samples were collected beneath the sumps at this AOC.

#### **2.2.15 AOC 12 - Former Contact Sulfuric Acid Plant Area B - Acid Storage Tank Area Sumps**

The location of AOC 12 is shown on Figure 2-2. This AOC consists of a series of AST areas along the eastern side of the contact building which were used primarily for the storage of oleum, 93 percent sulfuric acid, 99 percent sulfuric acid, fluorosulfuric acid, and hydrofluoric acid. Each of the tank areas is surrounded by concrete containment. Adjacent areas are also concrete paved. One or more sumps are present within the tank areas. The sumps are approximately 3 feet deep and lined with acid-resistant materials.

Based on the current status of the sumps and with concurrence from USEPA and DNREC, no soil samples were collected beneath the sumps at AOC 12.

#### **2.2.16 AOC 13 - Former Photosalts Plant Storage Tank Area Sumps**

The former Photosalts Plant Storage Tank Area is located in the eastern portion of the South Plant as shown on Figure 2-2. This AOC consists of a series of ASTs used to store ammonium thiosulfate, sodium thiosulfate, ammonium bisulfite, and sodium bisulfite. Concrete containment around the tanks does not exist, but all areas are paved. No documented spills occurred within the storage tank area. Within the tank area, two truck loading/unloading areas exist that contain transfer pumps and associated piping. Concrete containment surrounds these two areas. Sumps are present in each containment area. The sumps are approximately 3 feet in depth.

As part of RFI Phase II activities, the sumps were inspected. Based on the current status of the sumps and with concurrence from the USEPA and DNREC, no soil samples were collected from beneath the sumps associated with AOC 13.

#### **2.2.17 AOC 14 - Former Sulfuric Acid Storage Tank Area Sump**

This AOC is located within the southwestern portion of the facility (Figure 2-2) and consists of four ASTs used to store sulfuric acid. Photographs are included in Appendix D. The tanks are surrounded by concrete containment, and adjacent areas are concrete or asphalt paved. A sump is present within the eastern portion of the tank containment area. The sump is approximately 3 feet in depth.

As part of RFI Phase II activities, the sump was inspected. Prior to inspection, water and sediment that had accumulated in the sump since decommissioning were removed using a vacuum truck. Following coring through the base of the sump, a soil sample was collected from beneath the sump. The sample was analyzed for Appendix IX metals and pH.

Concentrations were above screening criteria for arsenic, antimony, and thallium. The concentration reported for arsenic was 946 mg/kg; and 2,300 mg/kg was detected in a duplicate sample from this location. Both concentrations exceeded the corresponding industrial RBC (1.9 mg/kg) and SSL (0.026 mg/kg). Antimony was detected in the duplicate sample from this location at a concentration of 23.8 mg/kg which slightly exceeds the corresponding SSL (13 mg/kg). Thallium was detected in the duplicate sample from this location at a concentration of 7.24 mg/kg which is slightly above the corresponding SSL (3.6 mg/kg).

Table 2-14 summarizes the results of the soil samples collected during the Phase II RFI. Figure 2-4 shows the arsenic concentration at this location relative to other site areas. Exceedances for antimony and thallium for the samples are shown on Figure 2-7.

#### **2.2.18 AOC 15 - Former Acid Loading/Unloading Area Sumps**

The location of AOC 15 is shown on Figure 2-2. Photographs are included in Appendix D. The former Acid Loading/Unloading Area was used for the transfer of

spent sulfuric acid from tanker trucks. The area is paved and contains two sumps that are interconnected. During decommissioning activities, the concrete pad was cleaned and the contents of the sumps were removed. The sumps are approximately 5 feet deep. No infiltration was noted during the cleaning of the sumps.

As part of RFI Phase II activities, the sumps were inspected. No significant deterioration was noted. Upon coring through the concrete and metal base of the sumps, water entered the sump which made it impossible to collect soil samples beneath the sumps. Therefore, attempts were made using a Geoprobe® to collect soil samples adjacent to the sumps and at a depth below each sump. One soil sample was collected in a boring adjacent to the southernmost sump at a depth coincident with the bottom of the sump (Sample AOC15-2). Several attempts were made to collect a sample adjacent to the northern sump. However, Geoprobe® refusal was encountered at several locations prior to reaching the depth coincident with the bottom of the sump and, therefore, a sample could not be collected. The sample adjacent to the southern sump was analyzed for Appendix IX metals and pH.

The only constituent exceeding screening criteria was arsenic. Its concentration was 6.42 mg/kg which exceeded the corresponding industrial RBC (1.9 mg/kg) and SSL (0.026 mg/kg). Table 2-14 summarizes the results of the soil samples collected during the Phase II RFI from this AOC. Figure 2-4 shows the concentration of arsenic at this AOC relative to other site areas.

#### **2.2.19 AOC 16 - Former Aboveground Fuel Oil Storage Tank C**

The location of AOC 16 is shown on Figure 2-2. Photographs are included in Appendix D. AOC 16 is a former AST used for the storage of Fuel Oil No. 6. The tank was installed in the late 1940s and has a capacity of approximately 640,000 gallons. A diked containment area, constructed of soil/fill and capped with asphalt, surrounds the tank. As part of decontamination activities, the tank contents were removed and the tank was cleaned. There have been no documented releases from the tank.

As part of Phase II RFI activities, the containment area was inspected for potential areas of breaching or cracking where a significant release could have occurred in the past. In



general, the asphalt cap is deteriorated in most areas, but no areas of major breaching or cracking were identified. Therefore, a total of six surface soil samples were collected on approximately equal spacing around and adjacent to the tank and within the containment area. Samples were collected using a hand auger and pick and were analyzed for Appendix IX metals, VOCs, and SVOCs. Sample locations are shown on Figure 2-3.

Concentrations were above screening criteria for arsenic, thallium, selenium, lead, and benzene. The following list summarizes these exceedances:

- The concentration of arsenic in each of the six samples from AOC 16 (ranging from 7.45 to 173 mg/kg) exceeded the corresponding industrial RBC (1.9 mg/kg) and SSL (0.026 mg/kg).
- One thallium exceedance was detected in one sample at a concentration of 3.71 mg/kg which is slightly above the corresponding SSL (3.6 mg/kg).
- Selenium was detected in one of the six samples (19.7 mg/kg) slightly above the corresponding SSL of 19 mg/kg.
- Lead exceedances were detected in five of six samples above the corresponding industrial RBC (800 mg/kg) ranging from 816 to 1,890 mg/kg.
- A benzene exceedance was detected in one sample at a concentration of 22 µg/kg which is above the corresponding SSL (1.9 µg/kg).

Table 2-15 summarizes the results of the soil samples collected during the Phase II RFI. Figures 2-4 and 2-5 illustrate the distribution of arsenic and lead at the AOC. Exceedances for the other constituents are presented on Figure 2-7.

### 2.3 SUMMARY OF FINDINGS

Based on the data evaluation presented above, the primary constituents found above applicable screening criteria across the facility were limited to arsenic, lead, and one PAH [benzo(a)pyrene]. Detections were found for several other metals such as antimony (four samples), thallium (six samples), and selenium (six samples), and chromium (17 samples). However, concentrations for each metal were below their respective RBCs

and, with the exception of selenium, were only slightly higher than their respective SSL values. Although selenium was about an order of magnitude higher than its SSL, its presence was limited to two areas (SWMU 3 and AOC 7).

Isolated detections were also found for several other organic compounds. In addition to benzo(a)pyrene, several other PAHs were detected above screening criteria. However, except for one sample location containing benzo(a)anthracene, these additional PAHs were all found in the SWMU 5 and SWMU 35 area and likely represent impacts from historical fill materials placed in this area. PCE, 1,4-dichlorobenzene, and benzene were detected above the corresponding SSLs at only one location each and at relatively low concentrations. Four sample locations contained low levels of PCBs, only slightly higher than the corresponding RBC or SSL.

Figure 2-4 illustrates the distribution of arsenic throughout the site based on the Phase II RFI soil sampling activities. It is apparent from this figure that no discernable pattern or rationale for the site wide distribution of arsenic emerges. Although arsenic concentrations for each sample exceeded the RBC and SSL, most of the samples outside of the SWMU 1, SWMU 3, and SWMU 5 areas were at concentrations less than 50 mg/kg. Several detections of arsenic were found in the central portion of the facility that ranged between 100 and 200 mg/kg. The one sample collected at AOC 14 had a relatively high concentration of arsenic. Within SWMUs 1 and 3, arsenic concentrations ranged from approximately 75 to 200 mg/kg.

Arsenic concentrations were most pervasive in the SWMU 5 area ranging in concentration from 20 to 800 mg/kg. Of the 39 samples analyzed, 15 samples ranged from 20 to 100 mg/kg, 19 samples ranged from 100 to 500 mg/kg, and 4 samples ranged from 500 to 800 mg/kg. The lateral and vertical distribution of arsenic concentrations across the sampling area was highly variable and did not indicate that its presence was from a single source.

Comparison of arsenic concentrations within each unit as well as between AOCs and SWMUs also shows a relatively high variability in concentration and depth. Furthermore, relatively high arsenic concentrations at sample points, such as those located within the AOC 16 area and beneath the sump at AOC 10 cannot be accounted

for from the most recent operations at these AOCs. Based on the historical operations of the facility, the likely source of the arsenic found across the site, including SWMU 5, is either from the former storage and management of pyritic ores or the placement, storage and/or deposition of pyritic ore cinders in these areas. The pyritic ore cinders were generated during the burning of the ore as part of the sulfuric acid manufacturing process and are expected to have higher arsenic concentrations than the raw ore product. The overall distribution of arsenic is not surprising given the age of the facility relative to the management of these materials and the likely spread of these materials from general handling practices, site filling and leveling, construction, excavation and grading, and similar site activities.

Figure 2-5 illustrates the distribution of lead concentrations above applicable screening criteria across the site. Most of the higher lead concentrations found at the site were within the SWMU 5 area. It is anticipated that the source of the lead concentrations in this area are also associated with the historical management of pyritic ore or pyritic ore cinders. Lead was also found above the screening criteria in five of the six samples collected at AOC 16, the former Aboveground Fuel Oil Storage Tank C. It is not anticipated that the fuel oil is the source of lead concentrations in this area, but rather inherent in the fill material, and possibly associated with pyritic ore/cinders. The several other isolated lead concentrations at AOCs 7, 9, and 10 that are noted on Figure 2-5 also appear to be related to the fill material and not impacted from the most recent operations/activities in those areas.

Figure 2-6 illustrates the distribution of benzo(a)pyrene in all areas sampled. Except for six locations, this compound was limited to the SWMU 5 area. Benzo(a)pyrene and other PAHs are common constituents in fill/soil materials at industrial facilities. Benzo(a)pyrene occurs ubiquitously in the environment from the incomplete combustion of fossil fuels, which is primarily released to the air and subsequently deposited onto the ground. It is also a constituent in coal tar which is used in asphalt paving, railroad ties, and roofing materials. Asphalt paving materials were present in the fill materials encountered during sampling as would be expected based on the history of the site. There are no known uses of this specific compound in past operations at the site.

In summary, the constituents arsenic, lead, and benzo(a)pyrene were found to be the most prevalent across the site. Based on the historical knowledge of the site, it is anticipated

that the presence of arsenic and lead are primarily associated with the past use of pyritic ores in the manufacturing process of sulfuric acid. Benzo(a)pyrene is a common constituent in fill at industrial sites, and appears unrelated to past historical operations at the facility. Management of risk associated with these potential constituents of concern in soil can be addressed in consideration of future site industrial use and specific redevelopment activities; therefore, no additional sampling is recommended.

## **3.0 RFI PHASE II GROUNDWATER INVESTIGATION**

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### **3.1 GROUNDWATER INVESTIGATION FIELD ACTIVITIES**

Groundwater samples were collected at the facility to assess groundwater quality, facilitate the placement of potential new monitoring wells, and assess the extent of groundwater impacts within the area of select existing monitoring wells. Continuous soil samples were collected from one representative boring from each sampling area and logged. An exception to this was AOC 11, where continuous samples were not collected<sup>1</sup>. Boring logs are presented in Appendix E. A laboratory analysis data report is presented in Appendix B-2, and the full data validation report is presented in Appendix C-2. Method detection limits and quantitation limits for each constituent are presented in Table 2 of the data validation report.

#### **3.1.1 Sampling Methodology**

Groundwater sampling was conducted using a Geoprobe<sup>®</sup> rig equipped with a Hydropunch<sup>®</sup> sampler. The RFI Phase II Work Plan (Work Plan) called for the Hydropunch<sup>®</sup> sampler to be advanced to a depth approximately 5 feet below the water table at each location; the depth of the water table below the ground surface was estimated to be generally in the range of 9 to 12 feet bgs. In several instances, the depth below the ground surface where the sample was collected varied from the Work Plan.

The groundwater samples were collected using a peristaltic pump with dedicated disposable tubing. Groundwater samples were collected using USEPA low-flow procedures, and the analyses of the samples followed the description in the approved Work Plan. The samples were identified with a unique alpha-numeric code and shipped for analysis under chain-of-custody control to Lancaster Laboratories, Inc., a certified analytical laboratory.

At several Hydropunch<sup>®</sup> sampling locations, the aquifer failed to yield sufficient water to collect a sample at the proposed sampling depth of approximately five feet below the

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<sup>1</sup> The shallow depth to groundwater and potential presence of buried utilities precluded continuous core collection.

water table. Where this occurred, the probe was advanced to greater depths until a zone that would yield sufficient water was encountered. The following sampling locations deviated from the Work Plan:

- **W112-HP04** - After attempting to sample groundwater five feet below the water table, it was determined that the aquifer would not produce sufficient water at that depth. Multiple attempts were made at acquiring a groundwater sample to 14 feet below the water table, when it was determined that the yield was too low, even at that depth to collect a sample. Samples were collected from the other three W112 groundwater sampling locations and analyzed for their respective parameters.
- **W106-HP04** - The aquifer only yielded sufficient water to collect VOC and SVOC samples. After collection of the VOC and SVOC samples, the borehole failed to recharge; however, sufficient water was yielded in the other three W106 sampling locations for analysis of their respective parameters.
- **SAL3-HP01** - After attempting to collect a groundwater sample five feet below the water table, it was determined that the aquifer would not produce sufficient water at that depth. Multiple attempts were made at acquiring a groundwater sample to 17 feet below the water table, when it was determined that the yield was insufficient, even at that depth to collect a sample. Samples were collected from three of the remaining four SAL-3 sampling locations.
- **SAL3-HP02, HP03, and HP04** - Hydropunch® locations were off-set as many as two times from each planned location after encountering subsurface refusal.
- **SAL3-HP05** - Hydropunch® location off-set five times due to encountering subsurface refusal before abandoning the location without collecting a groundwater sample.
- **W114-HP01** - Hydropunch® location off-set due to buried utilities.
- **W114-HP02** - After attempting to collect a groundwater sample five feet below the water table, it was determined that the aquifer would not produce sufficient water at that depth. Multiple attempts were made at acquiring a groundwater sample to 20 feet below grade, when

it was determined that the yield was insufficient, even at that depth to collect a sample. Samples were collected from the one other W114 sampling location.

- Due to the difficulty in collecting sufficient water from the water table aquifer, a soil sample was collected for grain-size analysis from within the saturated zone of W106-HP03 at a depth of 10 to 12 feet bgs. The sample analysis was performed according to American Society for Testing of Materials (ASTM) D 422. The test results indicate a high percentage of fine grained materials with 56.7 percent silt, 2.6 percent clay, and 14.9 percent fine sand (i.e., passing a #40 sieve). These data suggest that a predominance of fine grained sediments may be limiting formation yield at several of the borehole locations. The particle size report is included as part of the laboratory analysis data report presented in Appendix B-1.

### **3.1.2 Temporary Piezometers & Temporary Piezometer Sampling**

Four temporary piezometers were installed using the hollow-stem auger (HSA) drilling method. Soil samples were collected in accordance with ASTM D 1586-99 Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils. Continuously split-spoon sampling was conducted in advance of the augers. Upon retrieving the split-spoon sampler, each soil sample was visually classified and scanned with a photo-ionization detector (PID). All pertinent observations were recorded in the bound field book. The Work Plan required that soil samples be submitted for laboratory analyses if severely visually impacted soil was unexpectedly encountered. No such visually identifiable severely impacted soils were encountered, and no soil samples were submitted for laboratory analysis. The actual completion depth and length of screen were determined based on field observations.

The temporary piezometers were constructed of 2-inch diameter Schedule 40 polyvinyl chloride (PVC) with a 10-foot section of 0.010-inch slot PVC and a general completion depth of around 20 feet bgs. The temporary piezometers were placed so that the screened interval extended to approximately 5 feet below the water table. The annular space around the screen was backfilled with #1 Morie sand to approximately 2 feet above the screened interval. Two feet of bentonite pellets were installed above the sand pack and hydrated. Upon placement of a bentonite seal, the borehole annulus was grouted to grade with slurry of about 95 percent Portland Cement/5 percent bentonite grout. Each of the

temporary piezometers was completed with a protective flush-mount well cover set in a 2 foot by 2 foot by 0.5 foot well pad.

All soil cuttings were collected and placed in 55-gallon drums. All cuttings materials were disposed off site in accordance with state and federal regulations.

The new temporary piezometers were developed using the pump and surge technique. After surging, a submersible pump was lowered into the well and repeatedly raised and lowered throughout the screened interval until water quality parameters and the turbidity of the development water stabilized and no further variations were noted.

Prior to sampling, the depth to water and total depth of the on-site monitoring wells and piezometers were measured to the nearest 0.01 foot using a depth to water meter equipped with a water/product interface probe to evaluate whether light non-aqueous phase liquid (LNAPL) was present. Groundwater was purged from each of the new temporary piezometers using new, dedicated disposable polyethylene tubing. The flow rate during purging was measured by observing the time to fill a 100-milliliter (ml) graduated cylinder. Purge water was collected into 5-gallon buckets and stored in 55-gallon Department of Transportation hazardous waste certified drums.

During purging, pH, specific conductivity, dissolved oxygen, temperature, and turbidity readings were measured using a Horiba U-22 water quality meter. Depth-to-water readings were also recorded using a Solinst water level indicator. Stabilization of parameters for three consecutive readings of pH ( $\pm 0.01$  percent), specific conductivity ( $\pm 3$  percent), dissolved oxygen ( $\pm 10$  percent), temperature ( $\pm 3$  percent) and turbidity ( $\pm 10$  percent) was considered complete, provided at least five measurements had been taken.

### **3.1.3 Quality Assurance / Quality Control Sampling**

Groundwater analytical QA/QC samples were collected and submitted. The lack of adequate formation yield in several of the boreholes, in some instances, limited the ability to collect and submit all of the planned QA/QC samples. The QA/QC field sampling schedule was as follows:



**Matrix Spike / Matrix Spike Duplicate (MS/MSD):** One sample was provided in sufficient quantity such that an MS (and, for organic analytes, an MSD) could be generated in addition to an aliquot reserved for actual sample analysis for each sample delivery group. This sample included sufficient volume such that one re-extraction/reanalysis of the MS or MS/MSD pair could be performed if necessary.

**Field Duplicates:** The collection frequency of duplicate samples is 10 percent or one field duplicate for every 10 samples of the same matrix.

**Trip Blanks:** Trip blanks were prepared in the laboratory by pouring deionized, distilled water into sample vials. The trip blanks were then shipped from the laboratory to the field, and then returned with the collected groundwater samples back to the laboratory. Trip blanks were not opened in the field. The collection frequency for trip blanks was one per cooler of aqueous VOC samples shipped to the laboratory.

**Equipment Rinsate Blanks:** Rinsate blanks were submitted at a frequency of about one per every 10 groundwater samples collected. These included filter blanks which are prepared by passing laboratory-grade water through the filter-type being used during field filtration for dissolved metals fractions, and collecting the filtrate. The samples were analyzed for dissolved metals to evaluate the potential cause of cross-contamination by the filter.

### **3.1.4 Decontamination**

All equipment used during the groundwater investigation was decontaminated between each sample and/or measurement collected with a non-phosphate detergent rinse (e.g., Micro solution) and followed by a distilled/deionized water rinse. All decontamination water was containerized in 55-gallon drums.

### **3.1.5 Survey of Sample Locations**

The horizontal and vertical location of the Hydropunch<sup>®</sup> sample points and the temporary piezometers were surveyed by a ND Remy & Associates, a Delaware licensed surveyor. Datum were referenced to the Delaware State Plane Systems using the most recent horizontal datum (NAD 83) measured to third order specifications, and vertical datum

(NAVD 88) have an accuracy of 0.01 foot. The survey included measurements of the horizontal location, elevation at ground surface, the top of the outer casing, and top of the inner PVC casing.

### **3.2 RESULTS OF GROUNDWATER INVESTIGATION**

#### **3.2.1 MW-115 Area**

The locations of MW-115 and the new four temporary piezometers in the MW-115 area, W115-GW01 through W115-GW04, as well as summary analytical results are presented on Figure 3-1.

**Work Plan Objective:** During the Phase I investigation, LNAPL was identified in MW-115; however, the source of this LNAPL was unknown. Fingerprint analysis was comparable to kerosene or jet fuel. The Work Plan objective was to determine the extent of LNAPL observed in Monitoring Well MW-115 during the Phase I investigation, and associated groundwater impacts. Four temporary piezometers were installed in the area of Well MW-115. A groundwater sample was collected from each temporary piezometer and analyzed for Target Compound List (TCL) VOCs, TCL SVOCs, Target Analyte List (TAL) metals (total and dissolved) plus mercury, and TCL pesticides.

**Results:** LNAPL was not observed in any of the temporary piezometers (W115-GW-01, GW-02, GW-03 or GW-04) during the sampling event on January 2 and January 3, 2007. During the March 8, 2007 water level monitoring event, LNAPL was measured in MW-115 at a thickness of 0.4 foot.

Sample analytical data indicate that groundwater quality in the MW-115 area is impacted at low levels. Benzene exceeded its maximum contaminant level (MCL) in two of the temporary piezometers (less than 8 µg/l) and chloroform, 1,2-dichloroethane (1,2-DCA), and 1,2-dichloropropane (1,2-DCP) exceeded USEPA Region-III Tap Water RBC, but not their respective MCLs. Trace (i.e., less than 1 µg/l) levels of α- and β-BHC were detected and exceed USEPA Region III Tap Water RBC. δ-BHC (7.3 µg/l) exceeded both its MCL and RBC at W115-GW04. Dissolved arsenic (up to 238 µg/l), dissolved thallium (18.3 µg/l), and dissolved cadmium (22.4 µg/l) also exceeded their respective MCLs. A summary of the analytical results for groundwater samples from the four temporary piezometers are presented on Figure 3-1 and in Tables 3-1 through 3-5.

The non-detection of LNAPL using an interface probe lowered into each piezometer, and the absence of sheen or product in the purge and development water, suggests that the LNAPL is limited in extent to immediately near to MW-115. Similarly, the groundwater impacts appear to be localized and limited in extent. Therefore, no additional monitoring wells are recommended at this time.

### 3.2.2 MW-112 Area

Three of four proposed groundwater samples (W112-HP01 through W112-HP03) were collected via a Hydropunch® sampler. The sample locations, including the location of W112-HP04 and summary analytical results, are presented on Figure 3-1.

**Work Plan Objective:** Phase I sampling of MW-112 identified BTEX compounds in groundwater at high concentrations. The Work Plan objective of the Hydropunch® samples was to attempt to delineate the elevated concentrations of VOCs reported in Monitoring Well MW-112 during the Phase I investigation. The groundwater samples were analyzed for TCL VOCs, TCL SVOCs, TAL metals (total and dissolved) plus mercury, and TCL pesticides.

**Results:** VOCs were delineated north to Philadelphia Pike, to the south, and to the east. VOCs appear to be localized, and impacts due to chlorinated solvents appear to be associated with the maintenance building / welding shop in the area of the borings.

Trichloroethene (TCE) (75 µg/l) and PCE (10 µg/l) exceeded their respective MCLs at W112-HP01 located along Philadelphia Pike. Benzene, chloroform, 1,2-DCA, TCE, PCE, 1,2-DBA, and 1,4-DCB exceed USEPA Region III Tap Water RBC but not their respective MCLs at all of the W112 sampling locations. Trace (i.e., less than 1 µg/l) levels of 4,4'-DDT, dieldrin, α-, and β- BHC exceeded USEPA Region III Tap Water RBC at two W112 sample locations. Dissolved arsenic (46.6 µg/l) was detected above its MCL at one of the W112 locations. The BTEX compounds detected in MW-112 during the Phase I were detected at relatively low concentrations or were non-detect in the Hydropunch® samples. Results of the W112 samples are presented on Figure 3-1 and in Tables 3-1 through 3-5.

Based on the results of groundwater samples in the MW-112 area, the chlorinated solvents observed appear to be localized in the area of the maintenance building / welding shop and limited in extent.

### 3.2.3 MW-106 Area

A Hydropunch® sampler was used to collect four groundwater samples (W106-HP01 through W106-HP04) located near Monitoring Well MW-106, as presented with summary analytical results on Figure 3-1. The groundwater samples were analyzed for TCL VOCs, TCL SVOCs, TAL metals (dissolved and total) plus mercury, and TCL pesticides.

**Work Plan Objective:** Phase I groundwater sampling in MW-106 identified high concentrations of chlorinated solvents, primarily PCE. The Work Plan objective of the Hydropunch® samples was to attempt to determine the extent of the elevated concentrations of VOCs detected in Monitoring Well MW-106 during the Phase I investigation.

**Results:** No VOCs exceeded their respective MCL at any of the four W106 Hydropunch® sample location locations. At W106-HP01, *cis*-1,2-DCE, exceeded its USEPA Region III Tap Water RBC. Dissolved arsenic (79,100 µg/l and 66,400 µg/l) exceeded its MCL and USEPA Region III Tap Water RBC at W106-HP02 and HP03. *Cis*-1,2-DCE was the only chlorinated VOC detected during the Phase I in MW-106 and was also detected from the W106 Hydropunch® samples. Results of the W106 samples are presented on Figure 3-1 and in Tables 3-1 through 3-5.

Based on the results of groundwater samples in the MW-106 area, the groundwater impacts observed appear to be localized in the area of MW-106 and limited in extent.

### 3.2.4 SAL-3 Area

A Hydropunch® sampler was used to collect three of the five proposed groundwater samples (SAL3-HP01 through SAL3-HP05), located near Monitoring Well SAL-3, as presented with summary analytical results on Figure 3-1. Samples were not collected as planned from the SAL3-HP01 and SAL3-HP05 locations due to insufficient aquifer yield. The other three borings were relocated from their planned locations due to subsurface

refusal. The groundwater samples were analyzed for TCL VOCs plus acetonitrile, TCL SVOCs plus acetophenone and pyridine, TAL metals (total and dissolved) plus mercury, and TCL pesticides.

**Work Plan Objective:** Phase I sampling at SAL-3 identified acetone and methyl ethyl ketone at relatively high concentrations. The Work Plan objective of the Hydropunch® samples was to attempt to delineate the extent of the elevated VOC concentrations reported in groundwater at monitoring well SAL-3.

**Results:** Benzene (11 µg/l) and 1,2-DCP (16 µg/l) were detected exceeding their respective MCLs at SAL3-HP02. Chloroform, benzene, and methyl tertiary butyl ether were also detected in the SAL-3 area and exceeded their respective USEPA Region III Tap Water RBCs; but were below their respective MCLs. The SVOC pyridine was detected and exceeded its USEPA Region III Tap Water RBC, but at a concentration below its MCL. Generally trace (i.e., less than 1 µg/l) concentrations of pesticides 4,4 DDT, heptachlor epoxide, α-BHC, and β-BHC were detected, and exceeded their respective USEPA Region III Tap Water RBCs at three sampling locations. Dissolved arsenic (up to 770 µg/l), dissolved thallium (21.9 µg/l), and dissolved cadmium (19.6 µg/l) were detected at concentrations above their respective MCLs. Results of the SAL-3 samples are presented on Figure 3-1 and in Tables 3-1 through 3-5.

Based on the results of groundwater samples in the SAL-3 area, the groundwater impacts observed appear to be localized in the area of SAL-3 and limited in extent.

### 3.2.5 MW-114 Area

A Hydropunch® sampler was used to collect one (W114-HP01) of the two planned groundwater samples, as presented with summary analytical results on Figure 3-1. A sample could not be collected from W114-HP02 due to insufficient aquifer yield. The groundwater samples were analyzed for TCL VOCs, TCL SVOCs, TAL metals (dissolved and total) plus mercury, and TCL pesticides.

**Work Plan Objective:** The Phase I sampling at MW-114 identified relatively high concentrations of benzene. The Work Plan objective of the Hydropunch® samples was to attempt to delineate the extent of the elevated VOCs reported in groundwater at Monitoring Well MW-114.

**Results:** No VOCs were detected exceeding their respective MCLs; however, benzene exceeded its USEPA Region III Tap Water RBC. Trace (i.e., less than 1 µg/l) levels of dieldrin, α-BHC and β-BHC were detected exceeding their respective USEPA Region III Tap Water RBCs. Arsenic (23 µg/l) was detected at concentrations exceeding its MCL. Results of the W114 sampling are presented on Figure 3-1 and in Tables 3-1 through 3-5.

### 3.2.6 SWMU 1 Area

A Hydropunch® sampler was used to collect two groundwater samples at SWMU 1, as presented on Figure 3-1. The groundwater samples were analyzed for TAL metals (dissolved and total) plus mercury.

**Work Plan Objective:** Groundwater quality at SWMU 1 was not evaluated during the Phase I investigation. The Work Plan objective of these samples was to assess potential impacts from this unit on groundwater quality.

**Results:** Dissolved arsenic (9,050 µg/l) exceeded its MCL and its USEPA Region III Tap Water RBC. No other dissolved metals exceeded either their MCL or USEPA Region III Tap Water RBC. Results of the SWMU 1 sampling are presented on Figure 3-1 and in Tables 3-1 through 3-5.

### 3.2.7 AOC 11 Area

One Hydropunch® sample was collected at AOC 11. The actual location was approximately 70 feet hydraulically down-gradient and outside of the associated plant building containing the larger sump (the original Work Plan location) associated with this AOC as presented on Figure 3-1. The boring was relocated due to safety concerns in the interior of the building. The groundwater sample was analyzed for TCL VOCs, TCL SVOCs, TAL metals (dissolved and total) plus mercury, and TCL pesticides.

**Work Plan Objective:** Groundwater quality at AOC 11 was not evaluated during the Phase I investigation. The Work Plan objective of this sample was to assess impacts on groundwater quality from past use of the sump.

**Results:** No VOCs exceeded their respective MCLs at AOC 11; however, chloroform and benzene did exceed their respective USEPA Region III Tap Water RBCs. Concentrations of 4,4'-DDE (8.6 µg/l), 4,4'-DDD (9.5 µg/l), 4,4'-DDT (54 µg/l), dieldrin, and α-, β-, and δ-BHC (15 µg/l, 3 µg/l, and 1 µg/l, respectively) exceeded their respective USEPA Region III Tap Water RBC. Dissolved arsenic (124 µg/l), dissolved cadmium (77 µg/l), dissolved chromium (11,000 µg/l), dissolved nickel (8,840 µg/l), dissolved vanadium (5,390 µg/l), and dissolved zinc (13,900 µg/l) also exceeded their respective MCLs. Results of the AOC 11 sampling are presented on Figure 3-1 and in Tables 3-1 through 3-5.

### 3.3 WATER LEVELS AND GROUNDWATER WATER FLOW

Groundwater flow direction in the northern half of the site is generally to the south in the direction of the Delaware River as confirmed by the two Phase II water level measurement events of January and March 2007. In the southern half of the site (generally south of the Conrail right-of-way) groundwater flow direction becomes more south-southwest to westerly, becoming more parallel to the flow of the Delaware River. Groundwater contour maps for both measurement events are presented on Figures 3-2 and 3-3.

### 3.4 FINDINGS

#### 3.4.1 Groundwater Quality Findings

Instances of VOCs and SVOCs in groundwater, as well as their exceedance of MCLs or USEPA Region III Tap Water RBCs, appear to be localized and limited in extent and generally at low concentrations. Chlorinated solvents identified in the Phase II work appear to be locally limited to the extreme northwest corner of the site in Hydropunch® samples. They were not identified in the hydropunch samples in the vicinity of MW-106, although Phase I samples from MW-106 had relatively high concentrations of chlorinated solvents (primarily PCE). DDX compounds were present at three scattered locations and generally detected at less than 1 µg/l, although they were detected above 1 µg/l at

AOC 11. BHC compounds were locally present at six locations investigated; however, generally present at only trace levels (less than 1 µg/l). These compounds had higher concentrations at AOC 11 and SWMU 3 (MW115).

Dissolved arsenic was detected at concentrations exceeding the MCL, and is mapable over four general areas of the South Plant:

- Localized and limited in extent, at less than 50 µg/l in the vicinity of the MW-112 area in the northwest corner of the South Plant near Philadelphia Pike.
- An area limited in extent in the vicinity of AOC 7, AOC 10, AOC 11, and SAL-3 with concentrations ranging up to over 700 µg/l.
- Localized and limited in extent in the vicinity of the SWMU 3 (MW-115) area ranging up over 230 µg/l.
- An area over the southern half of the South Plant in the vicinity of SWMU 1 and SWMU 5. Concentrations in the vicinity of the SWMU 5 area range to over 79,000 µg/l. In the vicinity of SWMU 1, concentrations range to over 9,000 µg/l.

Dissolved metals other than arsenic included:

- MCL exceedances of dissolved cadmium, chromium, copper, lead, nickel, vanadium, and zinc were detected at AOC 11.
- Dissolved thallium and cadmium exceeded their MCLs in the SAL-3 and SWMU 3 (MW115 areas).
- Dissolved lead was in excess of the MCL at all four MW-115 locations (GW01 – 04), and one MW-112 location (02).

### **3.4.2 Conclusions and Recommendations for Further Groundwater Investigation**

With the exception of dissolved arsenic, all of the detected compounds appear to be localized and limited in extent. No additional Hydropunch® borings or permanent monitoring well installations are recommended.



## **4.0 CONCLUSIONS AND RECOMMENDATIONS**

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Based on the results of the Phase II RFI soil and groundwater characterization activities, it was concluded that additional RFI activities for these media are not warranted at the facility. In accordance with the RFI Work Plan, it is recommended that a draft final RFI report be prepared and submitted to USEPA incorporating the RFI Phase I results into the RFI Phase II report and completing the human health risk and ecological risk assessments outlined in the RFI Work Plan and subsequent correspondences.